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95

WIDE RANGE OSCILLATOR

TYPE 441A

INSTRUCTION BOOK

DAWE INSTRUMENTS LIMITED

95

OPERATING INSTRUCTIONS FOR

WIDE RANGE OSCILLATOR
TYPE 441A

DAWE INSTRUMENTS LIMITED
99/101 UXBRIDGE ROAD
EALING, LONDON, W.5
EALing 6215 (3 lines)

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1. SCHEDULE OF PARTS

The complete equipment comprises the following parts:—

1.1. One Instrument Type 441A fitted with the following valves:

Two — EF91 (Mullard)
Two — EL81 (Mullard)
One — EZ81 (Mullard)

Also:—

One — Cartridge Fuse 1A for 200-250V operation or 2A for 110V operation (Belling-Lee Type L1055)
One — Pilot Lamp 8V 0.2A M.E.S. cap, Vitality G 541.
One — Thermistor S.T.C. Type A1522/100 wired in the circuit.

1.2. One — Six-foot Mains lead fitted with 3-pin socket.

1.3. One — Plastic Dust Cover.

1.4. One — Instruction Book IB 441A.

2. DESCRIPTION

2.1. Application.

The Type 441A is a resistance-capacitance type oscillator continuously tunable over the range 5 c/s to 600 kc/s in five ranges. One instrument now provides complete coverage from sub-audio to low radio frequencies. This, together with the low distortion and constant output associated with resistance-capacitance tuned oscillators, will prove of particular value in vibration investigations, testing wide band amplifiers, as well as for most routine audio frequency measurements.

2.2. Controls.

The FREQUENCY dial calibrated from 5 to 60 c/s controls the setting of the three-gang variable capacitor in the frequency determining bridge of the oscillator circuit.

The five position MULTIPLIER switch, engraved X1, X10, X100, X1k, X10k, indicates the factor by which the FREQUENCY dial setting should be multiplied.

The AMPLITUDE control varies the setting of a bridged-T attenuator in the output circuit. The calibration units are purely arbitrary with maximum attenuation (minimum output) at the zero setting, and minimum attenuation (maximum output) in the fully clockwise position. The balanced output voltage appears at the two OUTPUT terminals. The third terminal marked " E " is earthed to the instrument case.

2.3. Circuit.

Essentially the circuit consists of a frequency controlling bridge feeding a balanced push-pull amplifier with cathode follower output and a power supply circuit.

The frequency controlling circuit consists of a modified Wien bridge. With no connection to earth at any point of the bridge the calibration is extremely stable since any stray capacitance or leakage to earth does not shunt the frequency controlling or the amplitude stabilizing arms of the bridge.

The resistance-capacitance networks determining the frequency are varied by operation of the MULTIPLIER switch and the FREQUENCY dial. The resistive arms of the bridge incorporate a thermally sensitive resistance element to stabilize the amplitude of oscillation at a level within the linear range of the push-pull amplifier. This, together with a large amount of negative feedback at harmonic frequencies ensures a very pure sine wave output.

The oscillator amplifier is a balanced push-pull circuit which includes a voltage amplifier stage, V1 and V2 and a cathode follower output stage V3 and V4. The bridge is fed from the cathodes of V3 and V4. The output of the frequency determining arm of the bridge is fed to the grid of V2 and the output from the amplitude stabilizing arm is applied to the grid of V1.

Within the overall negative feedback loop a controlled amount of positive feedback is applied over the output stage, giving nearly zero output impedance and thereby preventing variations in the load impedance from interacting with the circuit. The feedback loops are from the anode of V3 to the control grid and screen of V4 and from the anode of V4 to the control grid and screen grid of V3. The degree of positive feedback is a function of the load and increases as the load impedance decreases, thus tending to maintain a constant output level regardless of the load.

The output of the cathode-follower returns feedback to the frequency controlling bridge and supplies the primary winding of the output transformers coupling the oscillator to the output circuit. Transformer coupling isolates the oscillator from the output circuit and enables the output to be either balanced or unbalanced. Since a single transformer will operate correctly over only part of the frequency range covered by the instrument, two transformers are used. The appropriate transformer is selected by the MULTIPLIER switch. The secondary windings of the transformers are padded with fixed resistors to increase the source impedance from a very low value up to the rated 600Ω. The source impedance at the OUTPUT terminals remains constant at 600Ω and the instrument will operate into any value of resistive load.

The output level is continuously variable over a range of at least 20dB by means of a bridged-T attenuator.

The instrument is mains operated and housed in an attractively compact, modern style, black metal cabinet.

3. INSTALLATION

Read the label attached to the instrument and note the information given with respect to the valves and power supply.

3.1. Power Supply.

For supplies other than that stated on the label it will be necessary to adjust the mains selector switch at the rear of the instrument. This is a screw-driver adjustment accessible when the mains lead is unplugged.
With the MAINS switch in the OFF position connect to the mains supply by means of the lead provided.

Red	Mains (Line)
Black	Mains (Neutral)
Other Colour	Earth

3.2. Valves.

These are normally supplied fitted in their holders. The various types used are listed in Section 1.1.

4. OPERATION

4.1. **General.**

Switch the MAINS to ON and note that the red indicator lamp glows. Allow five minutes for the valve heaters to warm up. However, when first put into operation, or after standing idle for a long time the instrument should be run for at least 30 minutes before use. The frequency of the output voltage is determined by the setting of the FREQUENCY dial and the MULTIPLIER switch.

For example, to obtain a 1 kc/s signal, set the FREQUENCY dial to 10 and the multiplier switch to X100. Turn the AMPLITUDE control fully anticlockwise and make the connection from the OUTPUT terminal to the apparatus under test.
The output circuit of the Type 441A can be arranged for either balanced or unbalanced operation.

Unbalanced operation.

To operate with one side earthed, connect the earth terminal "E" to the OUTPUT terminal immediately above it, and take the test signal from the top terminal and the earthed pair.

Balanced operation.

Connect the "E" terminal to the chassis of the equipment under test and take the signal from the top two terminals.

The AMPLITUDE control in the output circuit is a continuously variable bridged-T constant impedance attenuator. With this type of attenuator it should be remembered that the output voltage is not reduced to zero at maximum attenuation. In this case the output is reduced by at least 20dB when the AMPLITUDE control is fully anticlockwise.

At all settings, except minimum attenuation, the attenuator unbalances the circuit, and, therefore, for balanced operation the AMPLITUDE control must be set for maximum output, that is, fully clockwise. Output balance is also a function of

frequency due to stray capacitance Up to 10 kc/s unbalance is less than 1% and at 500 kc/s is approximately 2%. If small outputs are desired or if balance at higher frequencies is critical, turn the AMPLITUDE control fully clockwise and connect an external attenuator, designed for the frequencies involved, between the Type 441A and the load.

Any value of load resistor may be connected to the output terminals with negligible effect on the performance of the instrument. Maximum power (100mW) transfer to the load, however, is obtained when the load resistance equals the source resistance which is 600Ω. Thus the maximum voltage available from the output terminals will vary from 15.5V on open circuit to 7.75V into 600Ω and down to practically zero for very small load resistance values.

No appreciable frequency shift occurs when the oscillator operates into a capacitive load. The only effect is reduced output voltage depending on the frequency and the value of the capacitance.

The distortion remains low and constant for all settings of the AMPLITUDE control and all load impedances.

5. MAINTENANCE

5.1. **Removal of Instrument Side Covers.**

Disconnect the instrument from the mains supply before attempting to remove the covers.

To gain access to the chassis proceed as follows:— Unscrew the single 4 B.A. chromium instrument head screw immediately above the DAWE nameplate at the bottom of both front and rear panels.

Remove the metal bezels by grasping the bottom edge and pulling forward and upward.

Grasp the top edge of one side cover and pull outwards to remove it completely. Similarly remove the other side cover.

The valves and chassis components are then readily accessible.

5.2. **Valves.**

The valves are standard commercial types and are not specially selected. However, if V1, V2, V3 or V4 are replaced the distortion in the output waveform should be checked. The distortion may be measured with an instrument which directly indicates the percentage distortion, such as the Dawe Type 700C Distortion Factor Meter.

The output voltage, 8V into 600Ω with the AMPLITUDE control set to maximum output voltage, will normally be unaffected by the replacement of the valves but, if necessary, it can be re-adjusted by the pre-set, potentiometer R11 located near V1.

5.3. **Frequency Calibration.**

The frequency calibration will ordinarily remain correct without adjustment. Internal pre-sets are provided but they should not be adjusted unless adequate testing facilities are available. An accurate frequency standard is essential. A

Distortion Factor Meter and a Valve Voltmeter are also required to ensure that the distortion and frequency response are within the specified limits after adjustment.

(a) Set the MULTIPLIER switch to X100 range and check the calibration at 5 on the FREQUENCY dial (500 c/s).

(b) If the calibration is incorrect, loosen the grub screws in the knob on the scale and shift the dial to put the point 5 on calibration.

(c) Set the output voltage to a known level.

(d) Check that 50 on scale falls at 5 kc/s.

(e) If incorrect decrease or increase C1 and C6 proportionally to increase or decrease the frequency at constant level of output voltage. When only one of the capacitors is adjusted a change in frequency and output voltage is obtained.

(f) Repeat (a) to (e) until the calibration is correct at both ends of the scale with the correct output voltage level.

(g) Check the 5 and 50 points on the X1, X10 and X1k ranges, adjusting R43, R44 and R45 respectively to set the multiplication.

If the 50 point on the X10k range is inaccurate adjust C4.

5.4. **Total Harmonic Distortion.**

The total harmonic distortion is approximately 0.25% at all frequencies except below 20 c/s where distortion increases up to about 0.5% to 5 c/s due to the output isolating transformer.

When valves are changed or when the instrument is recalibrated the output distortion should be checked with a Distortion Factor Meter.

6. SPECIFICATION

Frequency Range:	5 c/s to 600 kc/s in five ranges.
Accuracy:	± 3% including calibration error, warm-up drift and ageing effects.
Output:	100mW (7.75V) into 600Ω, balanced or unbalanced. 15.5V on open circuit. Source impedance 600Ω ±20%.
Output Control:	The output can be continuously varied over a range of at least 20dB at constant source impedance of 600Ω ± 20%.
Frequency Response:	± 1dB over the entire frequency range
Distortion:	Typical distortion figure is 0.25% at all frequencies, except below 20 c/s where the distortion increases to about 0.5% at 5 c/s.
Hum and Noise Voltages:	Less than 0.1% except near the mains supply frequency where the hum may increase up to about 0.2%.
Power Supply:	110 and 200-250V, 50-60 c/s, 70W approx.
Mounting:	Compact portable assembly in attractive modern style, black metal cabinet.
Dimensions:	6½ in. wide x 9½ in. high x 10 in. deep.
Weight:	19½ lb approx.

7. GUARANTEE

Our Products are carefully inspected and submitted to comprehensive tests at our factory before despatch. We therefore give to all purchasers (subject to the terms of payment and all the customer's other obligations being strictly observed) the following guarantee, which excludes and takes the place of any condition or warranty implied by Statute or otherwise.

If within three years from the date of despatch, any defect is discovered in any appartatus in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense, provided notice is given to us as soon as it is discovered, and that the apparatus is immediately forwarded to our factory, carriage paid and with seals unbroken. Our responsibility is in all cases limited to the cost of making good the defect in the apparatus itself. This guarantee is given to our customers and does not extend to third parties, nor does it apply to defects caused by wear and tear, abnormal conditions of working, accident, misuse or neglect.

In the case of material or components not of our manufacture, we are prepared to give the customer the benefit of any guarantee given us in respect thereof.

8. SERVICING PROCEDURE

The information given in this booklet should enable the user to maintain the equipment in proper working order. If difficulties arise, please write or telephone our Service Department or our Representative or Agent for your area or country. In certain cases we may be able to arrange for an outside service engineer to call on you.

When contacting our Service Department please mention the serial and type numbers of your instrument and include a full report of the fault encountered, as well as details of the action taken to eliminate it.

This information should be addressed to:—
Service Department, Dawe Instruments Ltd., 7/9 Spur Road, Isleworth, Middlesex. Telephone No. ISLeworth 8323.

If the equipment is returned for service, please include a copy of any relevant correspondence, together with all the accessories and the Instruction Book.

This procedure will facilitate the work of our Service Department and expedite the return of the instrument.

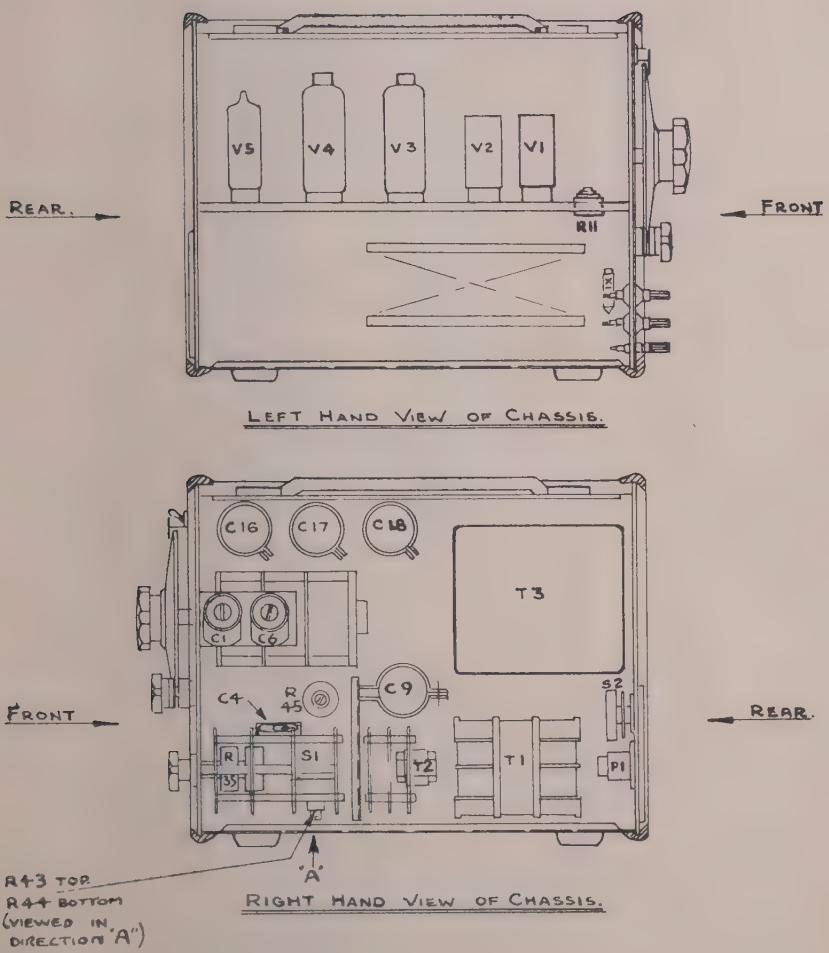


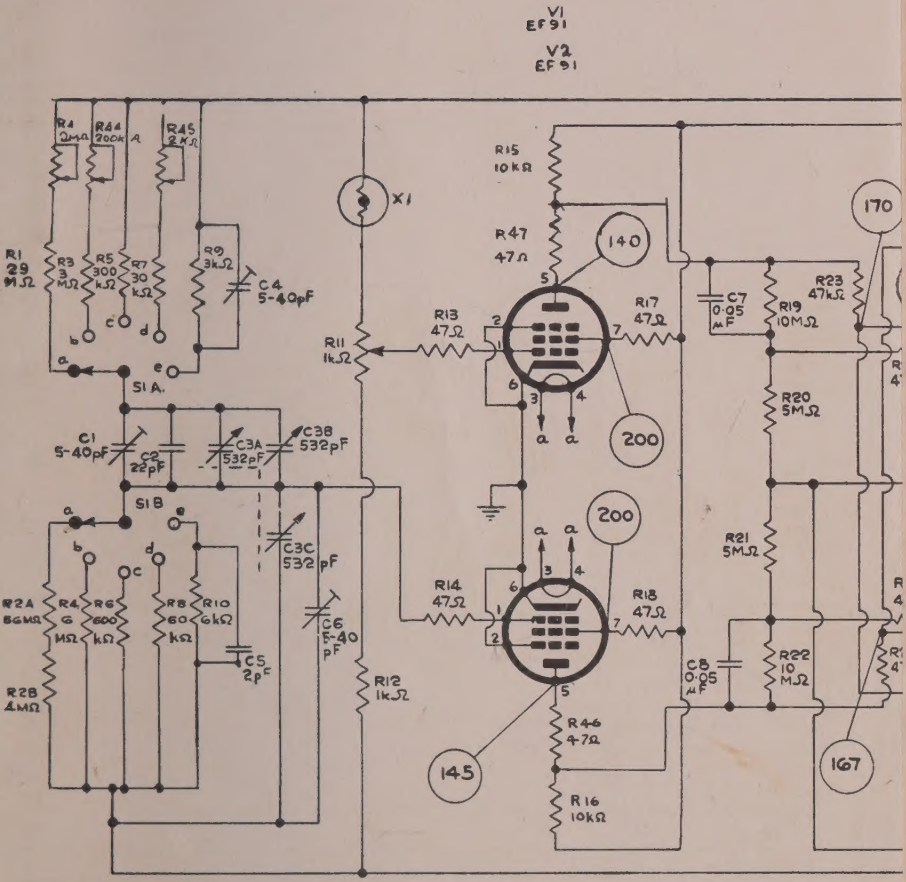
Fig. 1. LOCATION OF MAJOR COMPONENTS (C8868)

CIRCUIT COMPONENTS LIST

Circ. Ref.		RESISTORS	Tol.
R1	29MΩ	Welwyn Type C25	±2%
R2A	56MΩ	Welwyn Type C25	±5%
R2B	4MΩ	Welwyn Type C22	±5%
R3	2.9MΩ	Welwyn Type C24	±1%
R4	6MΩ	Welwyn Type C24	±1%
R5	300kΩ	Welwyn Type C22	±1%
R6	600kΩ	Welwyn Type C22	±1%
R7	29kΩ	Welwyn Type C22	±1%
R8	60kΩ	Welwyn Type C22	±1%
R9	3kΩ	Welwyn Type C22	±1%
R10	6kΩ	Welwyn Type C22	±1%
R11	1kΩ	Pot. Colvern Type 1106/9S	
R12	1kΩ	Welwyn Type C22	±5%
R13	47Ω	Erie Type 9	±10%
R14	47Ω	Erie Type 9	±10%
R15	10kΩ	Welwyn Type C22	±5%
R16	10kΩ	Welwyn Type C22	±5%
R17	47Ω	Erie Type 9	±10%
R18	47Ω	Erie Type 9	±10%
R19	10MΩ	Welwyn Type C22	±5%
R20	5MΩ	Welwyn Type C22	±5%
R21	5MΩ	Welwyn Type C22	±5%
R22	10MΩ	Welwyn Type C22	±5%
R23	47kΩ	Erie Type 9	±10%
R24	47kΩ	Erie Type 9	±10%
R25	47Ω	Erie Type 9	±10%
R26	47Ω	Erie Type 9	±10%
R27	2.2kΩ	Welwyn Type AW3115	±5%
R28	2.2kΩ	Welwyn Type AW3115	±5%
R29	220Ω	Welwyn Type AW3115	±5%
R30	220Ω	Welwyn Type AW3115	±5%
R31	220Ω	Welwyn Type C21	±5%
R32	220Ω	Welwyn Type C21	±5%
R33	270Ω	Welwyn Type C21	±5%
R34	270Ω	Welwyn Type C21	±5%
R35A	5kΩ	10% Log } Morganite Type	
R35B	5kΩ	90% Inverse Log } "AG" 2 Gang Pot.	
R36	600Ω	Welwyn Type C21	±5%
R37	600Ω	Welwyn Type C21	±5%
R38	6.8kΩ	Welwyn Type AW3112	±5%
R39	220Ω	Welwyn Type AW3115	±5%
R40	220Ω	Welwyn Type AW3115	±5%
R41	47Ω	Erie Type 9	±10%
R42	47Ω	Erie Type 9	±10%
R43	2MΩ	Morganite Type A Linear Grading	
R44	200K	Morganite Type A Linear Grading	
R45	2K	Morganite Type A Linear Grading	
R46	47Ω	Erie Type 9	±10%
R47	47Ω	Erie Type 9	±10%
R48	10Ω	Erie Type 9	±10%
R49	10Ω	Erie Type 9	±10%

Circ. Ref.		CAPACITORS		Wkg. Volts
C1	5-40pF	T.C.C. Type TCK0540		
C2	22pF	T.C.C. Type 101SMP ...	±10%	
C3 A,B,C	532pF	Wingrove and Rogers Type C6053/1		
C4	5-40pF	T.C.C. Type TCK0540		
C5	2pF	T.C.C. Type SCP4	±20%	
C6	5-40pF	T.C.C. Type TCK0540		
C7	0.05μF	T.C.C. Type CP35N	±20%	350
C8	0.05μF	T.C.C. Type CP35N	±20%	350
C9	108 to 120μF	Daly Type MSDA-J4/17 ...	...	110/125AC
C10	500pF	T.C.C. Type CM20N	...	350
C11	500pF	T.C.C. Type CM20N	...	350
C12		Inserted on test as required		
C13		Inserted on test as required		
C14		Inserted on test as required		
C15		Inserted on test as required		
C16	100μF	T.C.C. Type CE10LE	...	350
C17	100μF	T.C.C. Type CE10LE	...	350
C18	24μF	T.C.C. Type CE10P	...	450

Circ. Ref.	MISCELLANEOUS
F1	Fuse Belling Lee L1055 { 1A. 200-250V. operation / 2A. 110V. operation
LP1	Lamp 8V. 0.2A. Mes. Cap. Vitality G541
P1	Plug Bulgin P73
S1	Oak Switch N.S.F. D.I. Drg. No. C9134
S2	Oak Switch N.S.F. D.I. Drg. No. C9135
S3	Switch N.S.F. 8370/K8 (D.P.S.T.)
T1	Output Transformer Partridge Type TD5127
T2	Output Transformer Partridge Type TD5512
T3	Mains Transformer Partridge Type TD5246
V1	Valve Mullard EF91
V2	Valve Mullard EF91
V3	Valve Mullard EL81
V4	Valve Mullard EL81
V5	Valve Mullard EZ81
X1	Thermistor S.T.C. Type A1522/100


V1
EF91
V2
EF91
R1
29
MΩ
R4
2MΩ
R44
200k
A
R45
2MΩ
R3
3
MΩ
R5
300
kΩ
R7
30
kΩ
R9
3kΩ
C4
5-40pF
S1 A.
C1
5-40pF
C2
22pF
C3A
532pF
C3B
532pF
S1 B
C3C
532pF
C6
5-40
pF
C5
2pF
R2A
5GMΩ
R4
G
MΩ
R6
600
kΩ
R8
60
kΩ
R10
6kΩ
R2B
4MΩ
R12
1kΩ
X1
R11
1kΩ
R13
47Ω
R14
47Ω
R15
10kΩ
R47
47Ω
140
R17
47Ω
R18
47Ω
200
200
R46
47Ω
145
R16
10kΩ
C7
0·05
μF
C8
0·05
μF
R19
10MΩ
R20
5MΩ
R21
5MΩ
R22
10
MΩ
R23
47kΩ
170
167
EF91
EL81
EZ81
B7G
B9A. (NOVAL)
B9A. (NOVAL.)
X100
X10
X1
S1.
RANGE

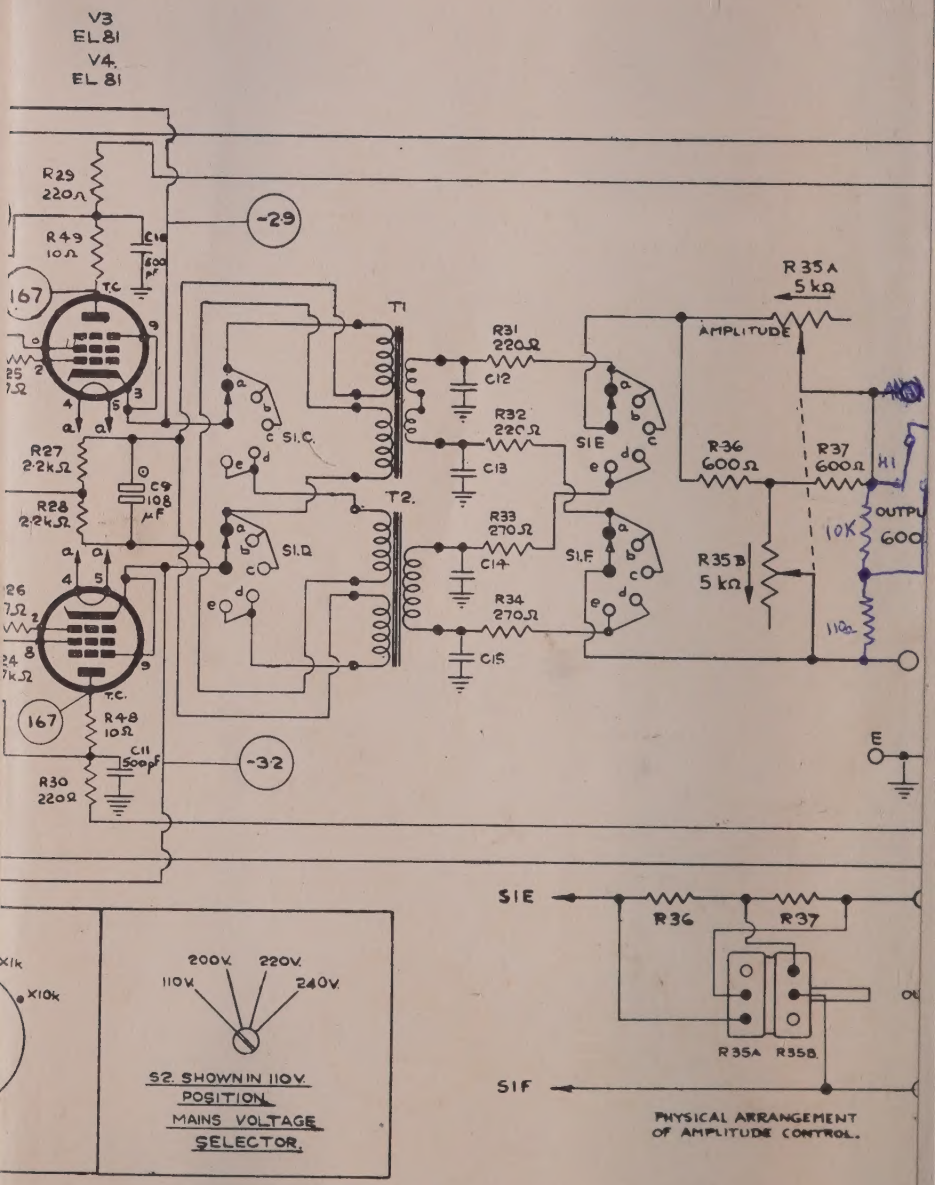


Fig. 2. CIRCUIT DIAGRAM (E8869)

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